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ABSTRACT

This guide addresses contributions that school facility administrators and business officials can make in an effort to reduce operating costs and free up money for capital improvements. The guide explores opportunities available to utilize energy-saving strategies at any stage in a building's life, from its initial design phase through renovation. The guide explains how design guidelines can help create high-performance school buildings. It also explores the use of energy equity to finance school energy improvements, and it discusses how smart energy decisions benefit schools, communities, and the environment. It further shows how much schools can save by making certain energy choices, and it establishes the link between daylighting and enhanced test scores. (GR)

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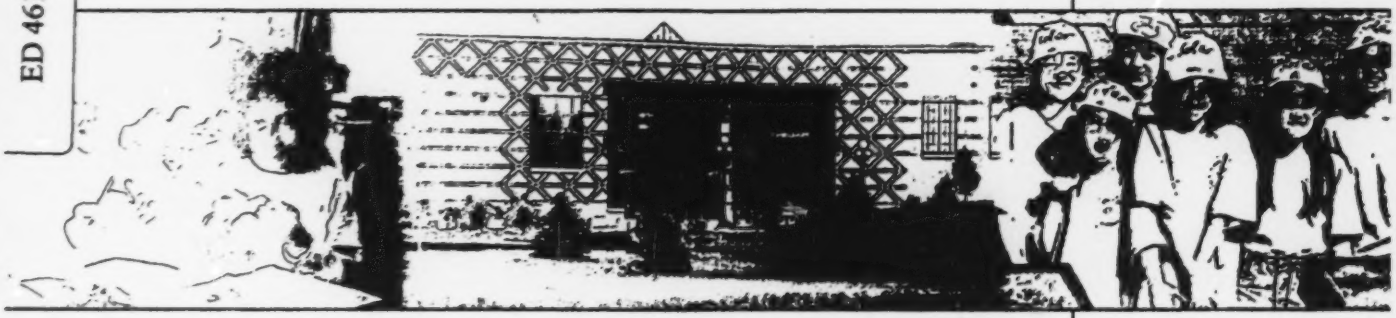
Energy-Smart Building Choices



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How school facilities managers and business officials are reducing operating costs and saving money

EF 006 059

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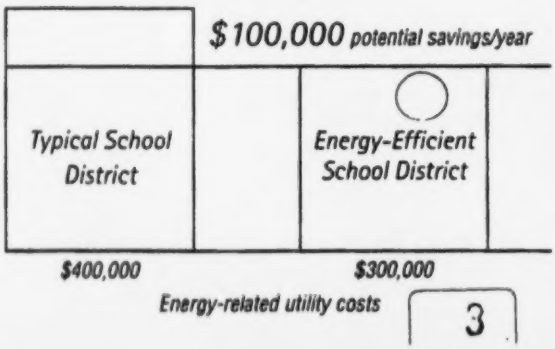
Smart Energy Choices Free Up Dollars for Capital Improvements

Operating a typical school today is no easy task for facilities managers and business officials. You're expected to deliver increased services with constrained operating budgets. Many schools stay open for longer hours to accommodate community use of the facilities. Dilapidated buildings and systems gobble up energy, yet in many districts, maintenance needs are overshadowed by the need for expansion or new construction to serve growing student populations and changing educational needs.

With the price of natural gas nearly double what it was just two years ago, energy costs over the life of a school may far exceed the initial cost of the building. A well-designed, energy-efficient new middle school for 900 students has the potential to save over $45,000 annually in energy costs. Over the life of the building, potential savings could reach over $7,700,000.

Energy-efficient improvements lower a school district's utility bills and maintenance expenses, enabling the district to redirect dollars to other needs. As a side benefit, many of the same improvements that help to lower a school's energy use also serve to improve the learning environment through better lighting, temperature control, acoustics, and air quality. Energy improvements have even been linked to improved student performance.

How much can you save?



A typical school district with 4,000 students pays over $400,000 for energy-related utilities each year. Incorporating energy-efficient design improvements could potentially save that district over $100,000 annually, enough to pay for three maintenance positions; replacement of gym bleachers; all roof maintenance, repair, and replacement needs over the life of the facilities; or annual requirements for instructional supplies.

Opportunities for Savings Exist on Multiple Levels

Districts building new schools have an opportunity to incorporate energy-saving strategies right from the start, in the design phase. Input from your operations and maintenance personnel can help the design team shape a functional school design and ensure the long-term success of the energy measures. Many schools are pleasantly surprised to find that energy-efficient choices do not necessarily mean increased costs if the features are planned from the beginning.

Building renovations can be just as energy smart: The replacement of aging systems with energy-efficient retrofits delivers short-term and long-term benefits. An efficient new heating, ventilation, and air conditioning (HVAC) system, for example, reduces your maintenance costs, makes classrooms more comfortable for students and teachers, and lowers long-term energy costs. You can create a positive domino effect by targeting your most inefficient systems first, and then using the energy savings to target additional capital improvements.

Ravenscroft School Saves $93,000 per Year

In an effort to improve comfort, reduce energy costs, and change the school's image, the Ravenscroft School in Raleigh, North Carolina, spent $1.4 million to implement building-shell improvements, integrate daylighting strategies, and install a large solar pool heating and hot water system. The energy improvements save $93,000 per year in energy costs and have reduced square foot energy costs by 20 percent.

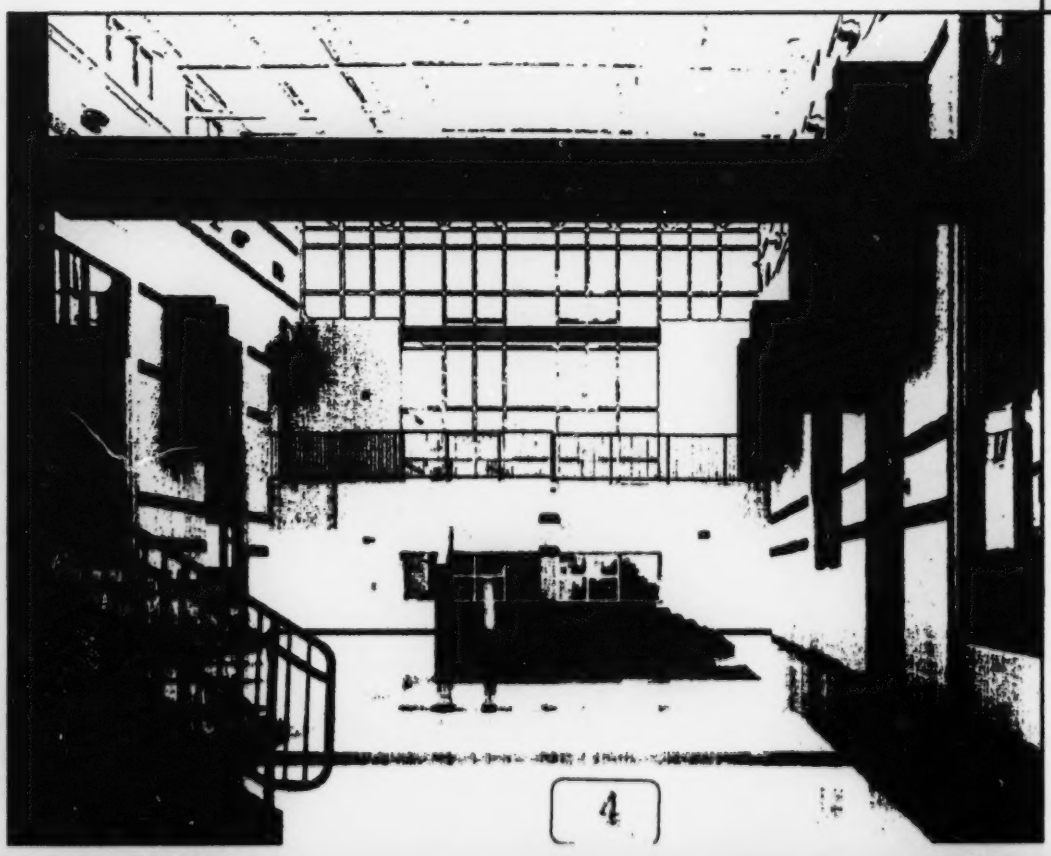


Photo by Hedrich Blessing, courtesy of Burt Hill Kosar Rittelmann Associates

Daylighting strategies at Clayton Middle School, Clayton, North Carolina (cover photo), and Grafton Middle/High School in Virginia Beach, Virginia (left), save money by reducing electric lighting needs as well as heating and cooling loads. The use of daylighting has also been connected to increased attendance and improved academic performance.

Rebates and Rewards Promote Saving Energy

To maximize their financial resources, Wake County Schools in Raleigh, North Carolina, have made saving energy a high priority. The schools have saved over $600,000 per year in energy bills, and much of this success is directly attributed to the training and involvement of employees and students. The school system encourages individual schools to save energy by offering each school 10 percent of the annual savings, and rewards maintenance staff at high-performing schools with special recognition and gift certificates. Programs like this help to instill an energy-saving ethic within the entire school culture.

Roof monitors at Four Oaks Elementary School in Four Oaks, North Carolina, use sunlight to light major occupied spaces within the school, reducing electric lighting needs as well as heating and cooling loads.

Design Guidelines Help Create High-Performance School Buildings

A host of interrelated considerations—from site design to transportation issues—factor into the creation of a "high-performance" school. To effectively integrate energy-saving strategies, these options must be evaluated together from a whole-building perspective early in the design process.

To do this, your school district will likely want to form a team of key players from the community and school to work in collaboration with your design team. The design team must have expertise in integrating energy and environmental considerations into school designs. Inputs from all of these stakeholders factor into good functional design and ensure the long-term success of your decisions.

The following list provides basic information about 10 key elements to consider when designing a high-performance school building. Your school district can include these elements in your Request for Qualifications (RFQ) or Request for Proposals (RFP) for design professionals. Once a design team is selected, comprehensive design guidelines available through the U.S. Department of Energy's EnergySmart Schools campaign can provide your team with detailed information on the following strategies.

Site Design

Orienting the building to maximize solar access boosts the effectiveness of daylighting strategies, reducing the need for electric lighting as well as heating and cooling loads. Designing the site to reduce or eliminate vehicular travel to the school helps to reduce fuel usage and emissions, improving the air quality in and around the school. Water requirements can be reduced by incorporating natural vegetation in the site design.

Daylighting and Windows

Increased use of daylighting helps to reduce electric lighting usage, and avoiding the heat generated by lighting fixtures helps schools use less conditioned air for cooling. Reductions in heating and cooling loads due to daylighting strategies often enable designers to downsize the HVAC system, reducing the initial cost of equipment as well as future replacement and utility costs. High-performance windows with low-e glazing also help to minimize heat gain in warmer months and heat loss in colder months.

Energy-Efficient Building Envelope

Increased insulation in the walls and ceiling helps to reduce heat loss and improve comfort. Light-colored exterior walls and white roofs help to reduce cooling loads. These factors also contribute to reducing the size and cost of the HVAC system needed as well as long-term operating and maintenance costs.

Renewable Energy Systems

Use of solar electric and wind technologies in conjunction with battery storage can provide security lighting, emergency power supply, or a source of steady power for sensitive equipment. Renewable energy systems can increase maintenance requirements, but they also reduce utility costs.

Lighting and Electrical Systems

Use of controls in daylit spaces can automatically reduce or increase light levels as needed. Occupancy sensors automatically turn off lights in unoccupied spaces. These options increase construction costs slightly, but pay back that increase in less than one year through energy cost savings.

Mechanical and Ventilation Systems

Using the whole-building approach, school designers can factor in energy-saving choices that reduce heating and cooling loads, and downsize the HVAC system needed. A smaller system reduces the initial cost of equipment as well as long-term operating costs. Computerized energy analysis programs can further improve the energy efficiency of the equipment installed.

Environmentally Sensitive Building Products and Systems

Schools can reduce complaints about indoor air problems and responses to inquiries from federal and state agencies by eliminating or minimizing:

- Volatile organic compounds (VOCs) in paints, carpet, and adhesives
- Formaldehyde in plywood, particleboard, composite doors, and cabinets

Water Conservation

Rainwater collection systems can provide water for toilet flushing and irrigation. The increase in construction costs is offset by longer-term reductions in water costs as well as the overall cost of energy used to deliver and process water. Water and wastewater costs can be reduced up to 50 percent.

Recycling Systems and Waste Management

Strategies to reduce landfill waste require contractors to recycle construction waste material. This approach can reduce costs up to $.90 per square foot for new construction, and up to $1.20 for renovations. Later, schools can involve students in comprehensive recycling efforts, reducing trash collection bills by up to 25 percent.

Transportation

Incorporating natural gas, biodiesel, methanol, or solar electric buses into a district's existing vehicle fleet helps to reduce fuel costs and harmful emissions. Lower fuel costs contribute to reduced operating and maintenance costs.

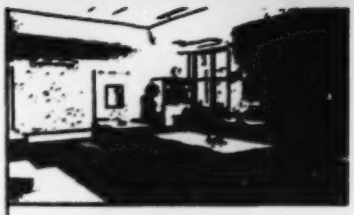
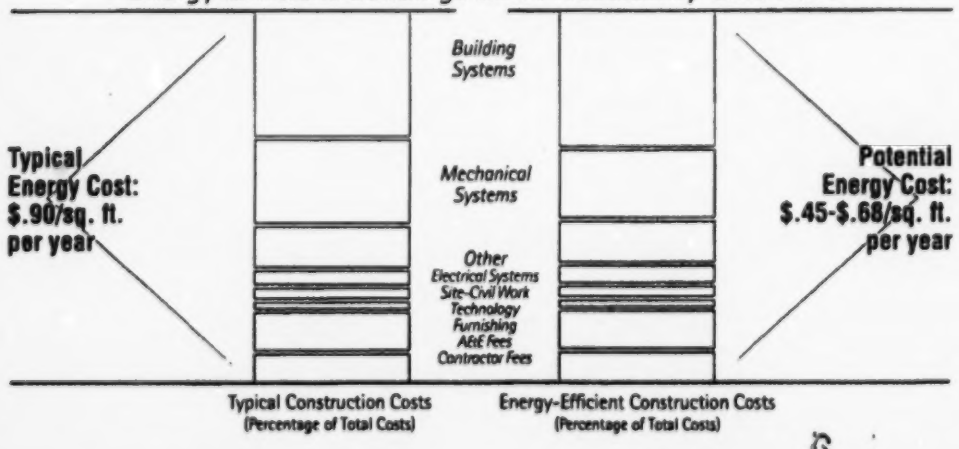


Photo: Robert Flynn

The cost of adding daylighting components to the design for Durant Road Middle School in Raleigh, North Carolina, was in large part offset by cooling and lighting load reductions—reductions made possible by the daylighting and building shell efficiency measures incorporated. The net initial cost was less than 1 percent of the total construction budget, and the investment was paid back to the school in energy savings within two years.

Energy-Efficient Buildings Don't Necessarily Cost More



Construction cost trade-offs often enable designers to incorporate energy-efficient features without a large increase in building costs. Incorporating daylighting features, for example, may increase the percentage of construction budget typically designated for building systems. However, the resulting load reductions enable designers to specify a smaller HVAC system, decreasing the percentage of construction costs needed for mechanical systems.

Pasco County Uses Mix of Financing Strategies

Pasco County Schools in Florida initiated an energy management program in the 1990s to improve the energy efficiency of its facilities. At the same time the district implemented an incentive program to encourage students and staff to change their energy behavior.

The combined impact has reduced the district's energy costs by over $1.1 million annually, despite a 31 percent increase in instructional space. Energy costs have been reduced by $.20 per square foot.

State energy grants and power company rebates helped the district pay for its initial energy improvements. Additional energy improvements were financed completely through energy cost savings.

Energy Equity Finances School Energy Improvements

Every school district considering energy options in its capital improvement plans faces the same problem: How to balance the initial cost of energy improvements with the life-cycle cost savings? One approach gaining popularity is to consider the energy inefficiency of your school facilities as a ready source of cash. Like home equity, this "energy equity" can be used to leverage a loan or to directly finance both energy and other facility improvements.

Energy performance contracts are one way of using your energy equity to implement facility improvements. Financing options available through energy service companies enable school districts to finance energy improvements based on the resulting energy savings. School districts face no initial costs and pay for the improvements with the money they save on energy bills. Once the improvements are paid for, districts can redirect the savings to meet other needs.

Many school districts are also surprised to find that their state, city, and local utilities offer grants and special programs to support the construction of energy-efficient buildings. When considering financing strategies, school districts should make sure to investigate all available options.

Smart Energy Decisions Help Schools, Communities, and the Environment

When a school reduces its energy consumption and saves money, everyone wins. Districts are able to redirect dollars to more critical needs, and taxpayer dollars are spent more wisely. Students, teachers, and maintenance staff enjoy a healthier, safer, and more comfortable and productive working environment. And the community benefits from cleaner air and reduced environmental impact of power generation.

Getting Started

If incorporating smart energy choices makes sense for your school district, the EnergySmart Schools campaign can help you get started. The campaign is administered through the Rebuild America program, a national DOE initiative to improve energy use in buildings. This means that if your schools part of a Rebuild America community partnership, you're already reaping the benefits of EnergySmart Schools. In fact, there are many initiatives in your area probably near the names of the companies.

Rebuild America and the EnergySmart Schools campaign can help you find out if your district has assets to complete another construction project, which type of new facility or renovated facility might best suit your district's needs, and how to finance the project. To learn more about the EnergySmart Schools campaign, visit the EnergySmart Schools website at www.eren.doe.gov/energysmartschools or call DOE's Energy Hotline at 1-800-DOE-3732 to have a Rebuild America representative contact you.

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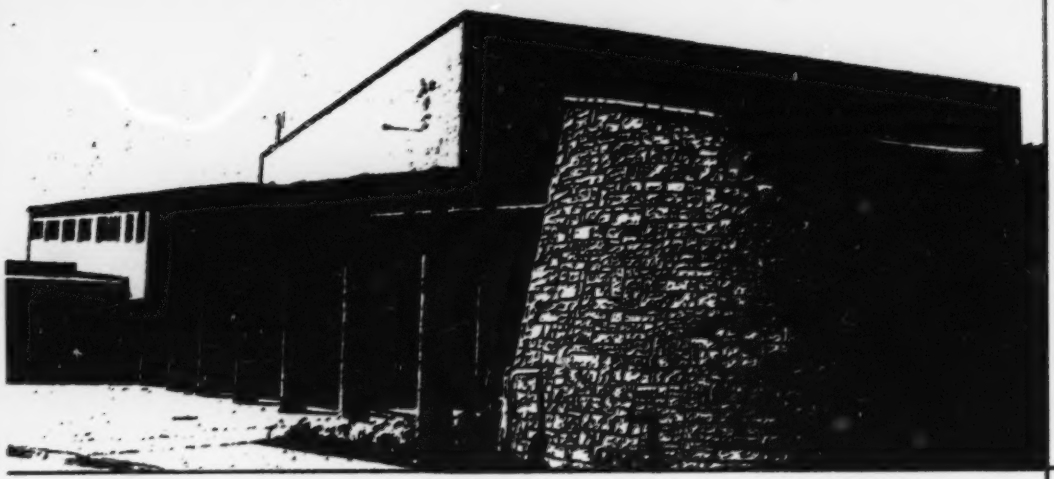

The design for Roy Lee Walker Elementary School in McKinney, Texas, incorporates numerous energy-efficient, environmentally sound features, including rainwater collection systems and cisterns like the one shown at left. This water conservation technology reduces long-term water costs as well as the cost of energy to deliver and process water.

For helpful resources or more information:

Call DOE's energy hotline: 1-800-DOE-3732

- *Ask a question about saving energy in your school or request information about the EnergySmart Schools campaign. You may want to inquire about the availability of the following EnergySmart Schools resources.*

Publications and videotapes

- *High-Performance Design Guidelines for new schools and major renovations in seven climate zones*
- *Portable Classroom Guidelines*
- *Designing Smarter Schools, a 30-minute videotape that originally aired on the CNBC television network*
- *EnergySmart Solutions for America's Schools, a 10-minute videotape produced by the Department of Energy*
- *Educational CD-ROM featuring teaching and learning materials*

Services

- *Technical assistance*
- *Regional peer exchange forums*
- *State-based forums for school decision-makers*
- *Financing workshops*
- *Technology workshops*

Visit the EnergySmart Schools website

- *Learn more about the campaign*
- *Find practical guidance for improving energy use in schools*
- *Tap into resources for teaching and learning about energy*

You may also wish to investigate other DOE programs or campaigns of value to schools: Clean Cities, a program aimed at helping communities adopt alternatively fueled vehicles and buses; the Million Solar Roofs Initiative, which helps schools and other organizations employ solar energy technologies; and the State Energy Program, a DOE program that provides grants to schools and other organizations and is administered through state energy offices.

Also, you can find information about how to install solar energy systems on your school via the Schools Going Solar initiative, which is sponsored by DOE. Your EnergySmart Schools representative can guide you to these resources, or you can find them through the DOE energy hotline and the EnergySmart Schools website.

www.eren.doe.gov/energysmartschools

Office of Building Technology, State and Community Programs
Energy Efficiency and Renewable Energy
U.S. Department of Energy

Energy Smart Schools
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